REMARKS

Careful consideration has been given by the applicants to the Examiner's comments and rejection of the claims, as set forth in the outstanding Office Action, and favorable reconsideration and allowance of the application, as amended, is earnestly solicited.

Applicants note the Examiner's rejection of the claims as being either anticipated or rendered obvious by the art of record, and applicants note that the claims, as amended and being presented herein, are deemed to clearly and patentably distinguish thereover.

Hereby, applicants note that Claims 1-5 and 11-15 have been rejected under 35 U.S.C. §102(e) as being anticipated by Oda, et al., U.S. Patent No. 6,489,668, as detailed in the Office Action. Furthermore, Claims 1-5 and 11-15 have been rejected under 35 U.S.C. §102(e), as being anticipated by Barber, et al., U.S. Patent No. 6,590,292, as also detailed in the Office Action, and, additionally, Claims 6 and 16 have been rejected under 35 U.S.C. §103(a), as being unpatentable over Oda, et al. in view of the Admitted Prior Art. Moreover, Claims 6, 7, 16 and 17 have been rejected as being unpatentable over Barber, et al. in view of the Admitted Prior Art; and Claims 8-10 and 18-20 have been considered as unpatentable over Oda, et al., as also extensively discussed in the Office Action.

However, concerning the foregoing, applicants note that the claims, as amended herein, are clearly and patentable directed to allowable subject matter, irrespective as to whether the prior art is considered singly or in combination.

In particular, applicants note that the purpose of the present invention is to overcome the disadvantages and drawbacks resulting from the mismatches in the coefficients of thermal expansion (CTE), which are presently encountered in the application of adhesives, which are employed to bond a heat spreader to a semiconductor chip in an electronic device. Thus, in

order to overcome the problems, the present invention provides for an adhesive bonding and component connecting structure constituted of a first silicone adhesive, which is electrically conductive and which is positioned in an essentially single and small-sized spot in an areal or center surface portion of the semiconductor chip, and with a further or second electrically non-conductive silicone adhesive, which is extensively larger than the surface area of the single spot, and which extends about that particular single spot constituted of the electrically conductive silicone adhesive for concurrently bonding the heat spreader to the semiconductor chip. In particular, the uses of adhesives adapted to compensate for mismatches in coefficients of thermal expansion (CTEs) and the resultant contraction, which are encountered between the various components, were limited in nature and difficulties were encountered in the employment of epoxy adhesives to absorb or desorb moisture.

Consequently, more recently, thermally conductive silicone adhesives have been employed in the attachment of heat spreaders to electronic components, which although they maintain adhesive properties and are constituted of low modulus materials, which reduce CTE mismatches are typically not electrically conductive. Thus, in order to provide for an appropriate electrical connection, which is desired between the heat spreader and the chip, it is important to provide a further adhesive, such as a electrically conductive adhesive, which is still subject to a mismatch in coefficients of thermal expansion with the other components.

Consequently, in order to provide for the appropriate compensation for mismatches while also enabling an electrical connection such that the metallic heat spreader is mechanically, thermally and electrically conductively attached to the backside of a flip chip, there is effected the concomitant use of both a thermally conductive electrically non-conductive silicone adhesive and also that of an electrically conductive silicone adhesive. In

order to provide the desired electrical connection and facilitating an adhesive bonding between the components, such as the heat spreader and the flip chip, while compensating for mismatches in coefficients of thermal expansion. Thus, pursuant to the invention, there is inventively provided the aspect of providing a single small-sized spot of an electrically conductive silicone adhesive generally centrally located on the flip chip and the central portion of the heat spreader, which is surrounded by the thermally conductive but electrically non-conductive silicone adhesive dispersed over a considerably larger surface area. This first-mentioned adhesive will provide for an electrical connection, while concurrently enabling a compensating for CTE mismatches through the use of the latter adhesive, and also result in a good mechanical adhesion between the heat spreader and the flip chip.

In order to provide the foregoing, the present invention thus contemplates a single small electrically conductive spot of silicone adhesive 18, as shown in Figure 1 of the drawings at spot 16, and which is essentially surrounded by a large surface covering electrically non-conductive thermosetting silicone adhesive 20. This will permit the mechanical connection without the difficulties of the mismatches and coefficients of thermal expansion (CTE), while also enabling the desired electrical connection through the adhesive 18 on the spot 16 between the heat spreader 14 and the flip chip 10.

To the contrary, the prior art does not in any manner disclose that type of connection between a heat spreader and a chip of an electronic device. The closest art resides in Oda, et al, U.S. Patent No. 6,489,668 B1, wherein the drawings show alternate spaced spots of electrically conductive and thermally conductive and non-electrically conductive adhesives being spaced about the entire surface are of the chip. However, the utilization of such electrically non-conductive adhesive over the area in a matrix would inhibit the compensation

between CTE mismatches, with such CTE compensation being primarily afforded through the present invention by limiting the electrically conductive silicone adhesive to merely a small central spot surrounded by the thermally conductive silicone adhesive possessing a lower modulus (CTE) extending over a larger surface area. Consequently, the matrix structure of the alternating types of adhesives employed in the patent to Oda, et al, would physically counteract and restrain any compensation mismatches in the CTEs, and thus would be subject to all of the disadvantages in the prior art, as referred to in the present specification and as currently known in the technology.

Barber, et al. is even further remote from the present invention in that it does not disclose a single central spot of an electrically conductive adhesive having a higher modulus of elasticity, which would be surrounded by a further thermally conductive and non-electrically conductive silicone adhesive having a lower modulus of elasticity. Consequently, Barber, et al., which does not show any structure of that nature, would be completely inapplicable to the invention.

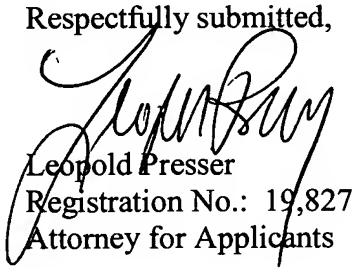
Accordingly, in order to more clearly emphasize the patentable distinctions over the art, irrespective as to whether Oda, et al. and Barber, et al. are considered singly or in combination, the main claims, in particular, have been amended to indicate that the adhesives are both silicone, whereas the electrically conductive silicone adhesive is positioned in an essentially single spot on a center or an areal surface portion of the semiconductor chip and with a further electrically non-conductive silicone adhesive of an extensively larger surface area than the said single spot extending about the electrically conductive silicone adhesive for concurrently bonding the heat spreader to the semiconductor chip. That type of arrangement and utilization of the two types of silicone adhesives, in the physical and areal proportions is

not at all disclosed nor suggested in the art, irrespective as to whether the cited patents are considered singly or in combination with each other, and in combination with any other art as submitted by applicants.

With regard to the dependent claims, although various of the materials per se are known in the art, these are deemed to be allowable in dependence upon clearly allowable amended independent Claims 1 and 11, which are directed to the patentable differences in the size and arrangements of the electrically conductive and electrically non-conductive, thermally conductive silicone adhesives, located intermediate the heat spreader and flip chip surfaces.

In view of the foregoing comments and amendments to the claims, which are deemed to set forth clearly allowable and patentable subject matter, the early issuance of the Notice of Allowance by the Examiner is earnestly solicited. However, in the event that the Examiner has any queries concerning the instantly submitted Amendment, applicants' attorney respectfully requests that he be accorded the courtesy of possibly a telephone conference to discuss any matters in need of attention.

Respectfully submitted,



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